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NOTES ON THE LACTIC ACID THEORY OF MUSCLE CONTRACTION

Arthur H. Bush, Opt.D., F.A.A.O.
Rochester, N. Y.

Nowhere in the world of thought do we meet with such constant rapid "building up" and "tearing down" of would-be "shrines" as in the scientific researches in the physiology of life. Here, an erstwhile "god" to whose "truth" scientists were doing homage is now no more than a discarded, forgotten idol.

One after another, theories of muscular contraction sprang up and flourished for awhile and then descended, discarded into the depths of oblivion. At present there is "enshrined," and "enthroned," the theory of muscular contraction known as the "Lactic Acid Theory."

It is my endeavor to state this theory the way I understand it, and bring out all the pros and cons with impartiality, basing my statements only on facts and data procured from the works of experimenters in that field.

Muscle is a machine by which chemical potential energy is ultimately converted into the potential energy represented by the tension set up in the muscle fibres in the act of contraction. In consequence of this, the muscle acts as though it were a stretched elastic structure capable, therefore, of exerting a pull on its extremities. If the muscle be allowed to shorten, this potential energy is partially converted into work.

Science is interested to find out how about and through what agencies is this tension-contraction brought about.

And it advances at present, the "Lactic Acid Theory."

But in order to state it in a way that should prove to be easily accessible to the understanding of everybody, we must delve a little in the intricacies of bio-chemistry.

The energy of bodily work is supplied by the food we take into our body. The food can be classified as inorganic and organic. The first group comprising water and mineral matter of salts, the other consisting of carbohydrates, fats and proteins. As the muscles depend for their energy upon the carbohydrates, I shall limit my discussion to them only. During the process of digestion, all the carbohydrates are changed to simple sugar. Most of this sugar passes into the capillaries of the small intestine. These capillaries pour their contents into the portal vein, which carries the blood, rich with glucose, to the liver. The liver cells take this glucose from the blood and by putting together a number of molecules and withdrawing water, the soluble glucose is changed into glycogen, which is stored into the cells of the liver. The liver doles out the glycogen into the blood stream, maintaining a certain constant percentage. From the blood stream, the glucose is taken up by the muscle and stored as glycogen for energy needs.

It was found by experiments that in a resting muscle, the minimum of lactic acid contained was only 0.015%. When the muscle has been stimulated to exhaustion, determination of the lactic acid showed it had reached a value of 0.16%. This percentage was found to be the maximum of concentration, at which point the muscle began to enter a state of rigidity. When the fatigued muscle was placed in oxygen, the lactic acid was found after some hours (in some cases, 24 hours), to have fallen again to a lower value if the conditions of access of oxygen to the muscle fibres are adequate. The removal of the lactic acid takes place in the muscle itself. Together with the reduction of the lactic acid, the muscle regains its excitability, and if it is then subjected to a farther exhaustive stimulation there is once more a development of lactic acid to the point of maximum concentration. In this way, the muscle could be fatigued and restored as long as it remained alive.

The inference from these experiments is that the lactic acid of the muscle is derived from the breakdown of some precursor when the muscle enters into contraction. Laboratory determinations showed that when a muscle is placed in an oxygen-free solution, the amount of lactic acid which accumulates is equal to the amount of glycogen. The acid will continue to accumulate as long as there is glycogen in the muscle, until a definite maximum is reached shortly after which the muscle dies if still kept without oxygen. As this absence of oxygen state changes and oxygen is let in, the muscle recovers and its return to function is accompanied by the definite chemical phenomena: disappearance of lactic acid, and increase of glycogen.

It follows then, that the chemical change of glycogen into lactic

acid is the precursor of such contraction. When lactic acid is added to a muscle it causes it to enter into a contracted condition. And it has been also proven by laboratory experiments that in all cases, the strength and extent of the resulting contraction runs parallel with the amount of lactic acid generated.

In the living muscle, there is a constant breaking down of the glycogen and a formation of the lactic acid which is thought kept at a definite amount and concentration by the blood stream which supplies the oxygen for its neturalization. This percentage of lactic acid in the resting muscle which amounts to 0.015%, keeps the muscle in its "tonus." During activity, when the muscle is stimulated, the chemical changes are only accelerated though qualitatively they remain the same. In the living, the richness of capillary supply gives very much more favorable conditions of recovery. This is seen by the fact that a blood fed muscle may be stimulated once each six seconds for an almost indefinite period of time without giving evidence of fatigue. Actual worked out laboratory calculations show that the rate of disappearance of lactic acid is about eight times as fast in a muscle in situ as in an exercised one. Another factor in determining the recovery of the muscle in situ is the possibility of lactic acid being diffused by the blood stream as soon as the rate of production begins to exceed the recovery velocity.

The muscle is then kept in tone by the constant minimum of lactic acid which seems to be physiologic. When there is a call for contraction of the muscle, what happens must be the following: The message (the nature of which is still undetermined), which is sent out by the brain through the nervous system, in some way causes the chemical change of glycogen into lactic acid; the latter working on the muscle fibres, produces their contraction. When these nervous impulses for contraction are periodic with equally regulated and rhythmic intervals of contraction and relaxation, the blood stream, during the period of relaxation, is able to neutralize the excess lactic acid and the recovery of the muscle follows. But if the periods of relaxation are less than those of contraction, the blood stream will be unable to neutralize the whole excess of the lactic acid formed, and soon the amount of "left over" of lactic acid will reach its maximum of concentration and bring the muscle into a state of fatigue.

What seems to be inconsistent with this theory of contraction and what it does not explain yet, are the following three outstanding laboratory experiments:

(a) That a muscle will reach the stage of rigor when all its glycogen is gone, though the muscle is still alkaline, i.e., that there is no lactic acid formation, as for instance, when the glycogen is entirely removed by large doses of insulin, the muscle passes at once into rigor as it dies.

(b) It would be anticipated that a theory of muscular contraction

which served to explain the phenomenon in striated muscles would also be transferable to the somewhat similar phenomena of plain muscles, but at the present time it does not come up to expectations. Experiments show that the addition of lactic acid to the plain muscle is most commonly to cause relaxation and not contraction, although they produce lactic acid under same conditions as the striated muscles.

(c) If a production of lactic acid brings about contraction, how can the fact be explained, that even in the absence of oxygen when the lactic acid is not removed, a muscle can still relax again?

Science has an explanation for each of the above mentioned inconsistencies, but does not consider them as entirely adequate. Nevertheless, the majority of investigators are of the opinion that lactic acid is the responsible substance and that the liberation of lactic acid evokes the contraction. This opinion, as I have said previously, is strengthened by the observation that the strength of a muscular contraction is proportional to the amount of lactic acid which is generated thereby, in fact, by all the observations which have been made on the origin and subsequent removal of lactic acid in striated muscles.

As to the manner in which the lactic acid, when it has been liberated brings about the state of contraction, there may be said to be four theories:

(1) The Surface Tension Theory.
(2) The Osmotic Theory.
(3) The Swelling Theory.
(4) Liquid Crystal Theory.

(1) "The Surface Tension Theory." According to this theory, the lactic acid raises the surface tension at the surfaces in which it is produced. If these surfaces are not spherical already, they tend to become so, and thus to induce shortening. But this theory is untenable because, as Meyerhof and Hill have shown by experiment and calculation in C. G. S. units (physical unit), the alterations in surface tension necessary to produce a force of one dyne would have to be much greater than any that it could produce.

(2) "The Osmotic Theory." This theory presupposes a semi-permeable membrane either at the surface of the fibre or somewhere within it. Production of lactic acid attracts water from the surroundings, and so brings about local swelling of the enclosed structure, which could conceivably lead to the shortening. But this theory is also discarded because since there has been a production of substances of low molecular weight from precursors of high molecular weight, this absorption of water is what might have been expected to happen.

(3) "The Swelling Theory." The opinion expressed in this theory is, that the production of lactic acid leads to an uptake of water by the cell celloids, while removal leads to a shrinkage of the

cell substances, and that excitation of the muscle is accompanied by profound alterations in the permeability of the surface membranes.

(4) "The Liquid Crystal Theory." This theory assumes that there is a film of liquid crystals in or upon the anisotropic (varying in irritability in different parts) substance, which might be caused to expand or contract by alterations in the angles of the latter, which change may be attributable to the effects of lactic acid. This is an attempt to find a theory of surface action which did not necessitate the occupation by the lactic acid of the whole of the surface. Of course this theory cannot be looked upon a certiori as the one of ultimate truth, but only a resting basis on the way of scientific research. It may well be expected that in the near future, science will find the real cause of muscular contraction in which glycogen and lactic acid are only component and resultant of some complex.

REFERENCES

Andrews—Bioch. Journal.
Evans—Journal Physiol.
Recent Advances in Physiology.
Myerhof—Chem. Dinamico of Life Phenomena.

DR. ARTHUR H. BUSH,
265 HENRIETTA STREET,
ROCHESTER, NEW YORK.

UNCOVERING LATENT HYPEROPIA

Emil Arnold, Opt.D.
Ann Arbor, Mich.

Of the many factors entering into refractive examinations, perhaps none prove so elusive as latent hyperopia, nor has any one piece of data been more sought for. Possibly it is well that this should have been so, for it has brought forth many different methods of diagnosis. Without the elusive "Latent" there would have been little need of atropine in the mind of the medical refractionist. In his search for a positive finding, paralysis of the accommodation was the means at hand. It uncovered many cases that were hidden in the old system of placing plus spheres on plus spheres, until cautioned to stop by the patient.

Without the handicaps encountered by latent it is possible that Dynamic Skiametry would not have attained its present popularity, nor would the Fogging System have been brought to the front as a means to furnish the total refractive error. How effective these methods are in bringing out the latent is largely a question of individual opinion. Each system, however, has its shortcomings. The patient does not care for Drops, the examiner does not dare to wholly rely upon his dynamic findings, and the wearer of fogging lenses does not take kindly to the blurred vision obtained through them.

With the above mentioned tests already well known it may seem superfluous to add another, but the simplicity of making it, the accurate check it has given the writer on other findings, and the advisability of always having many tests at one's command, prompts my offering the following because of its simplicity, its accuracy in checking distance findings and, particularly, its value in uncovering latent hyperopia.

The test is carried on as follows: With the distance findings as obtained by Skiametry, or subjectively placed before the two eyes, the patient is requested to read small type at a reading distanc, preferably at 13 inches, and plus spheres are gradually turned up before the two eyes simultaneously until the reading type is completely blurred **out.** From the amount of plus added to obtain blurred vision, subtract + 2.75 D. Sph. The resultant lenses before the eyes are the findings for the total Hyperopia. The consultant is then directed to look at the distant chart. In many cases, the vision through the resultant lenses is equal to that of the lenses found either by the preliminary skiametric or subjective tests. The difference, of course,

between the findings of the preliminary tests and those found through the plus lenses after deducting the + 2.75 D. Sph. is the measure of the Latent Hyperopia.

How much of this latent finding is to be prescribed in the final correction, is naturally dependent on the muscular conditions of the case without lenses and also with the correction in place, and also on the general complaints and symptoms of the case. The use of this piece of data, like that of all other data gathered in our examinations should be analyzed before the final correction is given.

In reviewing this test, it is obvious that if the pair of eyes is corrected for distance and the patient is then directed to read at 13 inches, there is brought into play, three diopters of accommodation. Inserting the plus lenses gradually relaxes the accommodation and theoretically it should take a pair of + 3.00 D. Spherical lenses to counteract the accommodation. If it takes more than this, then the correction for distance is an undercorrection. Simple as this analysis may seem, it is interesting to note that the same test will not apply for Myopes and Presbyopes. The fact that it does not apply opens another field of investigation of Accommodation and Convergence Relationship. Experimental measurements are being made now in the effort to apply the test to Myopes in the hopes that it may help to solve reductions of corrections in Myopic cases.

Let it be stated in closing that the test is not new nor original, but its application seems to be little known. It has been tried in practice for several years in thousands of cases and has been the check test that guided proper corrections in hundreds of cases when other routine tests would have failed or had failed.

DR. EMIL H. ARNOLD,
ANN ARBOR, MICH.

REFERRED EYE DISORDERS, WITH FOUR ILLUSTRATIVE CASES BY THE AUTHOR.

J. O. Baxter, Opt.D.
New Bern, N. C.

One of the most unfortunate things that may happen, and play havoc to a practitioner of any school, is to treat, or mistreat a condition that falls under the domain of a different science.

An irritation of any nerve is apt to be referred to any division of the nerve involved, and unless the practitioner knows the anatomy and physiology and how to group the symptoms of these lesions, he cannot render the best service to his patient.

Optometry cannot hold the confidence of its patients and of other sciences if it endeavors to correct referred eye disturbances that arise from infections of the teeth, tonsils, gastro-intestinal tract or what not, by optical aids. If we wish to meet other major sciences on equal ground, we must in the first place be in a position to render safe, intelligent service to our patients.

It is of course obvious that no man can be dentist, physician, optometrist and what not, but any one can learn enough of the major sciences into which his own overlaps, to avoid being placed in the unhappy position of rendering service that not only could do no good, but perhaps harm.

The capable physician is not an optometrist or dentist, and he does not have to be in order to recognize a dental or optometrical condition, but his elementary knowledge of other allied sciences permits him to avoid the grievous error of treating medically, dental or ophthalmic lesions; neither will he hesitate to use dental or optometric aids to determine these conditions.

If we are to render such safe service to our patients on equal grounds we cannot refuse to equip ourselves with the proper education and instruments, to be enabled to recognize any pathology that is related to the eyes.

Focal infections often cause organic and functional lesions of the eyes. By far, those that occur the most frequently and are the easiest to locate are found in the mouth, the teeth and tonsils. These infections cause pain and congestion in the eyes, motor disorders (phorias and spasm of accommodation), iritis, chronic conjunctivitis and other serious diseases. Iritis often causes sound teeth to ache through referred irritation. It is fairly obvious that the optometrist

should be enabled to recognize these things that so vitally affect his work.

Transillumination and blood pressure work often leads to important discoveries that are unsuspected by the patient. Routinely following each branch of the retinal vessels with the opthalmoscope, I have found to be good practice. Often sclerotic changes are noticed in their incipiency before the condition has become general, other lesions of the fundus are also quickly found by this system. A few cases and sequences may be of interest.

Case One.

Mrs. B—. Had been examined for glasses by a practitioner in a neighboring city and told that no glasses could improve her vision which was 20/200 with cataracts. By taking her blood pressure (which was [systolic] 190) and referring the case to the family physician, she was found to have a serious kidney disease. Plus 4.00 D. cylinders gave her 20-50 vision.

Case Two.

Mrs. H—. Suffered with violent eye disorders and nervous symptoms. Her oculist was consulted and he prescribed glasses. Results were negative. Was referred by her family physician to an optometrist for examination. Her glasses were not correct, but she could have used them, but, by following the course of the retinal vessels, to many terminal and tortuous arteries, indents at the point of crossing the veins were noted. Her physician was called in and the condition shown and explained to him. Exhaustive tests for focal infections were made and none found except a suggestion of two clouded teeth with X-ray. One of them was extracted, it was sound and no infection found. Three days later a profuse flow broke through the wall of the adjoining suspected tooth. The patient is now much improved.

Case Three.

Mrs. P—. Had excruciating headaches and nervous symptoms, thyroid symptoms and spasm of accommodation. A local oculist had fitted her with concave lenses. Her family physician referred her to the optometrist. Transillumination revealed a few alveolar abscesses and pyorrhea and a refraction revealed about two diopters of plus lens. Her physician thinks the thyroid disease will clear up after removing the focus of infection in the mouth. The fifth nerve, which is both motor and sensory to the jaw and teeth, communicates with the motor-oculi. Through this connection, the spasm of accommodation may have arisen by the irritation of the alveolar processes, and referred to the motor nerves of the eyes. Perhaps such infections are the cause in spasm of accommodation cases. The headaches

were relieved when plus lens were prescribed and the mouth was cleaned up.

Case Four.

Mrs. B—. For several months called the physician at all hours to relieve severe pains in the lower abdomen. The case was diagnosed as gall stones with advice to operate at once. The irritation of the fifth pair of nerves in the eye communicates with the pneumogastric, which supplies the gall bladder and gastro intestinal tract. The pain was referred from the eyes to the abdomen, as the discomfort was immediately relieved with no recurrence in several months. The physician is one of our best, and the patient may yet have gall stones, but now objects to the operation.

DR. J. O. BAXTER,
NEW BERN, N. C.

A CASE OF DIPLOPIA AT THE NEAR-POINT

Chester H. Johnson, Opt.D.
Philadelphia, Pa.

Patient, Miss L. D. Age 46. Occupation, school teacher. Patient came to me first in the latter part of 1926. She had been suffering from a nervous breakdown, and had just been discharged from a hospital. She was very weak, and was still suffering from a very noticeable near-point diplopia, which naturally made teaching impossible. At that time, stereoscopic treatments were suggested, but her condition also made the giving of these impossible, and she was discharged, with the following prescription to be used until her health improved.

Distance Correction.
O. D. + 2.00 D. Sph.
O. S. + 2.00 D. Sph.
Reading correction.
O. D. + 4.00 D. Sph. ⊃ 8Δ Base In.
O. S. + 4.50 D. Sph. ⊃ 8Δ Base In.

This near-point prismatic correction gave her single binocular vision for periods varying from ten to thirty minutes.

In December, 1927, she returned for treatments, her health now being somewhat better. These were given daily for six weeks. At the start of the treatment, she had naturally no adduction at all and her abduction was some 16 prism diopters. The technic used was stereoscopic treatments, using the stereo-phorometer with a pair of plus 10.00 D. Sph. for a working distance of 10 cm. developing convergence both positive and negative, with the following results:

December 16, 1927. Patient reported some improvement. Her positive convergence (adduction) was now 2 or 3 prism diopters. On January 10th, 1928, this had increased to 8 prism diopters and her negative convergence (abduction) was now 22 prism diopters. By the 26th of the same month, additional improvement was reported by the patient and on the 1st of February, her positive convergence was some 20 prism diopters. On February 10th the treatments were discontinued, her positive convergence being 26 to 30 prism diopters and her negative convergence being 18 prism diopters. Her correction was then changed to the following:

Distance correction.
O. D. + 2.50 D. Sph.
O. S. + 2.50 D. Sph.
Reading correction.

O. D. + 5.00 D. Sph. ⊃ 3Δ Base In.
O. S. + 5.00 D. Sph. ⊃ 3Δ Base In.

She now has complete control of the accommodative convergence functions at the near-point, being able to read with comfort for several hours at a time.

I have found the following technic to be most beneficial in cases of this kind. The stereo-phorometer is placed before the patient, a pair of plus 10.00 D. Sph. interposed, the cards being placed at 10 cm. This holds the accommodation in check and enables one to work entirely on convergence, the prisms being turned base out about 1 P. D. at a time with a dead stop of about five seconds between each increase. After five to ten minutes of this, the charts are placed at 33 to 36 cm., the plus 10.00 D. Sph. being removed, and the treatment repeated, with the accommodation in full force, both positive and negative convergence being stimulated.

DR. CHESTER H. JOHNSON,
5144 WALNUT ST.,
PHILADELPHIA, PA.

A FEW NOTES ON THE PROPOSITION, "LIGHTS WHICH DIFFER IN COLOR DIFFER ALSO IN DEGREES OF REFRANGIBILITY," BY SIR ISAAC NEWTON, FROM HIS MEMORABLE WORK ON "LIGHT," WRITTEN IN 1675, PUBLISHED IN 1704.[1]

Fay McFadden, Opt. D.
Rutland, Vermont

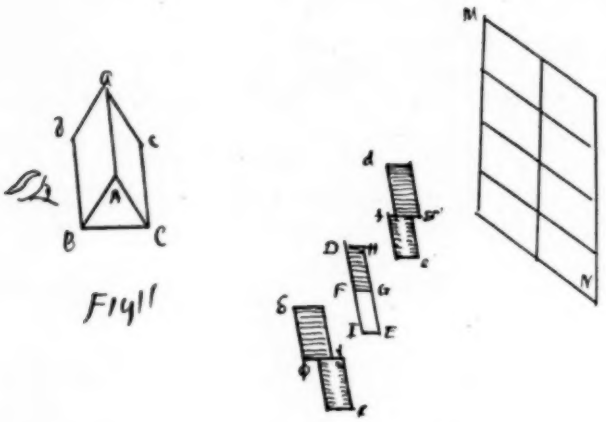
"Lights which differ in Colour, differ alfo in Degrees of Refrangibility.

The Proof by Experiments.

Exper. 1. "I took a black oblong ftiff Paper terminated by Parallel Sides, and with a Perpindicular right Line drawn crofs from one Side to the other, diftingiifhed into two equal Parts. One of these Parts I pained with a red Colour, and tl.e other with a blew. The Paper was very black, and the Colours intenfe and thickly laid on, that the Phaenomenon might be more confpicuous. This Paper I viewed through a Prism of folid Glafs, whofe two Sides through which the Light paffed to the Eye were plane and well polifhed, and contained an Angle of about Sixty Degrees: which Angle I call the refracting Angle of the Prifm. And whift I viewed it, I held it before a Window in fuch a manner that the Sides of the Paper were parallel to the Prifm, and both thofe Sides and the Prifm parallel to the Horizon, and the crofs Line perpendicular to it; and that the Light which fell from the Window upon the Paper made an Angle with the Paper, equal to that Angle which was made by the fame Paper by the light reflected from it to the Eye. Beyond the Prifm was the Wall of the Chamber under the Window covered over with black Cloth, and the Cloth was involved in Darkefs that no Light might be reflected from thence, which by paffing the edges of the Paper to the Eye, might mingle itfelf with the Light of the Paper and obfcure the Phaenomenon thereof. Thefe things being thus ordered, I found that if the refracting Angle of the Prifm be turned upward, fo that the Paper may feem to be lifted upwards by the Refraction, its blew half will be lifted higher by the Refraction than its red half. But if the refracting Angle of the Prifm be turned downward, fo that the Paper feem to be carried lower by the Refraction, its blew half will be carried fomething lower thereby

[1][This is the second of four papers inspired by the undoubtedly interesting perusal of Sir Isaac Newton's book, "LIGHT." In this paper as in the first, the Author has been careful to reproduce the exact spelling and wording as used by Newton. In the third and fourth papers, however, the theories of, and conclusions drawn by Newton, will be reviewed by McFadden in his own language.]—**Editor, American Journal of Optometry.**

than its red half. Wherefore in both cafes the light which comes from the blew half of the Paper through the Prifm to the Eye, does in like Circumftances fuffer a greater refraction than the Light which comes from the red half, and by confequence is more refrangible.



"Fig. 11. Illuftration. In the Eleventh Figure, MN reprefents the Window, and DE the Paper terminated with parallel Sides DJ and HE, an by the tranfverfe Line FG diftinguifhed into two halfs, the one DG of an intenfely blew Colour and the other FE of an intenfely red. And BACcab refrefents the Prifm whofe refracting Planes ABba and ACca meet in the edge of the refracting Angle Aa. This edge Aa being upward, is parallel both to the Horizon and to the parallel edges of the Paper DJ and HE. And de reprefents the Image of the Paper feen by Refraction upwards in fuch a manner that the blew half DG is carried higher to dg than the red half FE is to fe, and therefore fuffers a greater Refraction. If the edge of the refracting Angle be turned downward, the Image of the Paper will be refracted downward fuppofe to SZ, and the blew half will be refracted lower to QZ than the red half is to SY.

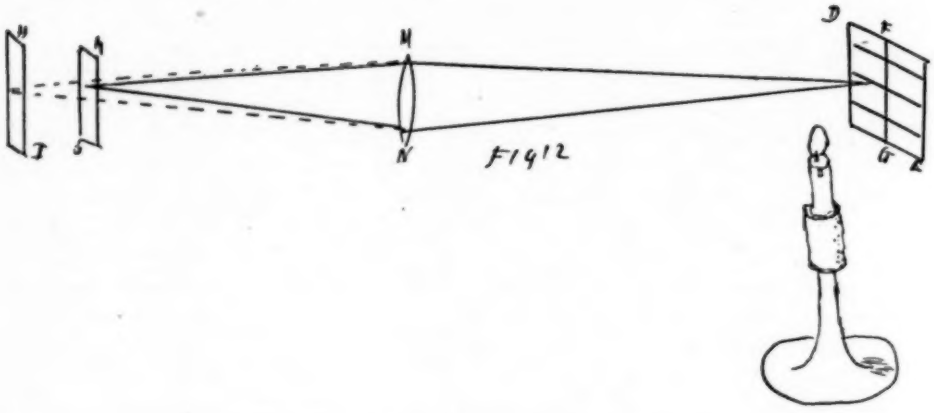
"Experiment 2. About the aforefaid Paper, whofe two halfs were painted over with red and blew, and which was ftiff like thin Pafteboard, I lapped several times a flender thread of very black Silk, in fuch manner that the feveral parts of the thread might appear upon the Colours like fo many black Lines drawn over them, or like long and flender dark Shadows caft upon them. I might have drawn black Lines with a Pen, but the threads were smaller and better defined. This Paper thus coloured and lined I fet againft a wall perpendicularly to the Horizon, fo that one of the Colours might ftand to the right and the other to the left. Clofe before the Paper at the confine of the Colours below I placed a Candle to illuminate

the Paper strongly. For the Experiment was tried in the Night. The flame of the Candle reached up to the lower edge of the Paper, or a very little higher. Then at the Diftance of Six Feet and one or two Inches from the Paper upon the Floor I erected a glafe Lens four Inches and a quarter broad, which might collect the Rays coming from the feveral Points of the Paper, and make them converge towards fo many other Points at the fame distance of fix Feet and one or two Inches on the other fide of the Lens, and fo form an Image of the coloured Paper upon a white Paper placed there; after the fame manner that a Lens at a hole in a Window cafts images of Objects abroad upon a Sheet of white Paper in a dark Room. The aforefaid white Paper, erected perpindivular to the Horizon and to the Rays which fell upon it from the Lens, I moved fometimes toward the Lens, fometimes from it, to find the places where the Images of the blew and the red parts of the coloured Paper appeared moft diftinct. Thofe places I eafily knew by the Images of the black Lines which I had made by winding the Silk about the Paper. For the Images of thofe fine and flender Lines (which by reafon of their blacknefs were like Shadows on the Colours) were confufed and fcarce vifible, unlefs when the Colours on either fide of each Line were terminated moft diftinctly. Noting, therefore as diligently as I could, the places where the Images of the red and blew half of the Paper appeared moft diftinct, the blew half appeared confufed, fo that the black Lines drawn upon it could fcarce be feen; and on the contrary when the blew half appeared moft diftinct, the red half appeared moft confufed, fo that the black Lines upon it were fcarce vifible. And between the two places where thefe Images appeared diftinct there was the diftance of an Inch and a half: the diftance of the white Paper from the Lens, where the red half of the coloured Paper appeared moft diftinct, being greater by an inch and a half than the distance of the fame white Paper from the Lens when the Image of the blew half appeared moft diftinct. In like Incidences therefore of the blew and the red upon the Lens, the blew was refracted more by the Lens than the red, fo as to converge fooner by an Inch and a half, and is therefore refrangible.

"Figure 12. Illiftration. In the Twelfth Figure, DE fignifies the coloured Paper, DG the blew half, FE the red half, MN the Lens, HJ the white Paper in that place where the red half with its Black Lines appear diftinct, hi the fame Paper in that place where the blew half appeared diftinct. The place hi was nearer the lens than the place HJ by an Inch and a half.

"Scholium. The fame things fucceed notwithftanding that fome of the circumftances be varied: as in the firft experiment when the Prifm and Paper are in any way inclined to the Horizon, and in both when coloured Lines are drawn on very black Paper. But in the Defcription of thefe Experiments, I have fet down such Circum-

ftances which either the Phaenomenon might be rendered more confpicuous, or a Novice might more eafily try them, or by which I did try them only. The fame thing I have often done in the following Experiments: Concerning all thif one Admonition may fuffice. Now from thefe Experiments it follows not at all that all the Light of the blew is more refrangible than all the Light of the red; for both



Lights are mixed of Rays differently Refrangible, So that in the red there are fome rays not lefs Refrangible than thofe of the blew, and in the blew there are fome Rays not more Refrangible than thofe of the red; but thefe Rays in Proportion to the whole Light are but few, and ferve to diminifh the Event of the Experiment, but are not able to deftroy it. For if the red and blew Colours were more dilute and weak, the diftance of the Images would be lefs than an Inch and a half; and if they were more intenft and full, that diftance would be greater, as will appear hereafter. Thefe Experiments may fuffice for the Colours of Natural Bodies. For in the Colours made by the Refraction of Prifms this Propofition will appear by the Experiments which are now to follow in the next Propofition."

DR. F. McFADDEN,
RUTLAND, VERMONT.

A POSSIBLE PREVENTION AND CORRECTION FOR MINER'S NYSTAGMUS

Charles I. Saks, Opt.D.
Syracuse, N. Y.

Miner's nystagmus, to the writer's knowledge, has never been successfully treated or corrected, without necessitating the afflicted miner giving up his work. With this in mind, the writer has developed the following theory, but it is to be borne in mind that the suggested technique has never been tested by the writer owing to a lack of suitable patients, but the suggested treatment has, nevertheless, been derived from known facts.

If the eyes, when fixating an object at the reading point, be made to follow the upward movement of this object, the head remaining in its primary position, it will be noticed that convergence becomes more difficult as the eyes are elevated. If convergence (or binocular fixation) is to be maintained for any length of time at a point above the level of the eyes, the oncoming of ocular fatigue, or difficult fixation, will be experienced in a short time, even though the object of fixation be about five or six feet away. The effect of such fixation will be felt still more so if this is kept on all day. It can at once be seen, therefore, that convergence is difficult for fixation points above the level of the eyes.

Drs. Maddox, Stevens and Peckham, have all found that abduction is highest when the eyes are elevated, or in other words, convergence is at a minimum when the eyes are in this upturned position. This is proved by placing equal amounts of base-down prism before each eye and noticing the abduction with and without the vertical prisms. Just the opposite is true when equal amounts of base-up prism are placed before each eye, that is, induction is thereby at a maximum.

If, then, convergence (or binocular) fixation is more difficult when the eyes are elevated, it can at once be seen how a miner is affected. In working with a pick and shovel, he must fixate at points about two to three feet in front of him. It is a difficult thing to try keeping the head erect, hence he must avert his eyes instead, it being the easier of the two. The treatment suggested by the writer, therefore, is equal amounts of prism BASE-UP before each eye, say about 3$^{\Delta}$ base-up, O.U. for constant use.

It is to be remembered that the suggested treatment is based on known ocular myological facts. The writer, however, has never been

fortunate enough to test out this theory on nystagmic cases among the miners themselves. It has been suggested that the faulty illumination and the presence of carbon monoxide are contributing cause of miner's nystagmus. If carbon monoxide is a contributing cause, then why is nystagmus not found among gas house workers? To the writer's way of thinking, it is difficult to see how faulty illumination can cause nystagmus, because miners are not required to do minute fixating.

The writer has observed one or two cases, in his own practice, where no manifest nystagmus existed, but an oscillation could be observed when the eyes were made to elevate.

DR. CHARLES I. SAKS,
428 SOUTH GEDDES STREET,
SYRACUSE, NEW YORK.

OCULAR PSYCHOMETRY

Being an Outline of the Fundamental Principles Governing the Control of the Ocular Muscles.

By
Carl F. Shepard, O.D., D.O.S.
and
Wm. Arthur Mendelsohn, Oph. D., Opt. D.
Chicago, Ill.

CHAPTER VII.

Worth[36] states that the eyes of a new-born infant will momentarily fixate a light flashed into the eye in the dark, although the fixation will be imperfect and will not be binocular, even for a few seconds, until after five or six weeks. Zoethout[37] states that binocular fixation is not established until at least the sixth month.

According to Von Hippel[38] the fovea is not fully developed for several months after birth and Zoethout[39] states that fusion does not make its appearance until near the end of the first year.

Authorities on physiological optics seem well agreed that the faculties of vision appear in approximately the following order:

1. Pupillary constriction to light.
2. Monocular fixation.
3. Concomitance (one eye following the other).
4. Binocular fixation.
5. Form conception.
6. Color conception.
7. Fusion.
8. Perspective sense.

The exact order of appearance may vary slightly according to different observers, but there is obvious agreement in that the motor reactions to *any* light precedes mental interpretation of pattern, intensity, or color of light focused on the retina.

Common knowledge and simple logic surely demonstrates that motion adjustments must precede mental interpretation.

F. Treacher Collins,[40] Zoethout (already cited) and others give tables of indirect acuity which, interpreted in terms of "Snellens standard" mean that visual acuity (form conception) diminishes as the object of regard is moved away from the line of direct vision approximately as follows:

Direct visions normal acuity.....20/20
Normal acuity 3° from line of direct vision.....20/70
" " 5° " " of " " 20/80
" " 10° " " of " " 20/250
" " 20° " " of " " 20/800

Obviously, the eye must be turned to fixate the object of regard before correct interpretation can be had of it; even then, 20/20 vision would not be possible until the ciliary muscle had operated to bring about a sharp focus of the image upon the macula.

Optometrists who have investigated the "fusion powers" of their patients know from experience that such powers increase when acuity is improved and diminish when the acuity is reduced. It is also well known that retinal images cannot be "fused" if one of them falls outside of a very limited area immediately surrounding the macula.

It is, therefore, an unavoidable conclusion that correct determination of the nature of any given object and its exact position in space—in short "seeing"—is a matter of direct vision, or macula stimulation, *made possible by previously accomplished adjustments of the extrinsic and then the intrinsic ocular muscles.*

If it should be determined in a given case that interpretation of direct macula stimulation was alone at fault—that is to say, if fusion, perspective and direct visual acuity were below normal and *no muscular imbalance of any type could be discovered,* then only would it be proper and correct to proceed in the development and improvement of those higher visual faculties, ignoring completely the more primitive.

But if there be demonstrated esophoria, exophoria, cyclophoria, hyperphoria, hypophoria, convergence excess, convergence insufficiency, sluggish fixation, inaccurate excursion (attempting to follow a fixation object moving through a fixed pattern) "premature presbyopia" or faults of concomitance (one eye following its mate inaccurately when covered) then intensive development of the higher faculties such as fusion, without first correcting these more primitive functions would be like unto building a house upon an insecure foundation, or upon the sands.

When faults of these deeper, more primitive visual faculties are present, and they frequently are, the conscientious builder of comfortable eyes will see to their correction before he builds an elaborate superstructure upon an unsafe foundation. He will follow as nearly as possible the building program of Old Mother Nature. He will first of all determine whether or not each eye turns instantly, easily and accurately to fixation of conspicuous moving objects unexpectedly appearing several degrees away from the line of direct vision while the patient's conscious attention is held "neutral" by a casual conversation. The latter provision—neutral attention—is included be-

cause movement to fixation is essentially an innate reflex action observable in the new-born infant long before the infant's mind is capable of conscious attention.[41]

Having improved the most primitive ocular function (fixation) by the proper exercise thereof, the next step would be to determine whether or not each eye were capable of vergence movements to the normal extremes and whether or not the extreme positions could be occupied without undue effort, attention, or discomfort.

Third, concomitance should be investigated and if either eye discloses a reluctance to follow its mate, though covered, that reluctance should be overcome by leading each eye in turn through various movements until, through concurrent experience, either becomes exact in following the other's movements.

To accomplish this, it is necessary to provide a moving fixation object which, though following an uninterrupted path in space, is visible, then invisible, to each eye in turn. The alternation of visibility from one eye to the other must be at intervals of from one second to a fraction of a second, the rate of alternation to be regulated according to the promptness of the fixation response. Such optometric means fortunately are now available. With the establishment of an exact concomitance and equi-efficient fixation, all heterophoria will quite naturally have disappeared. Incidentally, the rapidity of alternate attention when increased sufficiently leads alternating squint and suspenopsia to binocular vision and fusion.

Actual and clinical experience demonstrates the correction of these prior-fusional faculties to be accomplished in the most obvious and simple manner conceivable; that is, by exercise of the most primitive ocular reflex actions, fixation of, and following conspicuous moving objects.

This chapter would not be complete if it closed without reference to the exercise of the smallest muscle bodies within the human eye, which respond to the stimulus of light according to the intensity thereof, as a pure reflex action not under the control of will—the cone myoid.

F. Treacher Collins[42] says:

> "Supposing now the image of a black letter on a white ground, such as we have in our best types, be focused on this delicate mosaic of cones, those upon which the white background is projected will be stimulated and contract, those upon which the black letter fell, not being stimulated, will remain uncontracted. Indeed, it seems likely that if we could examine the outer surface of a retina so stimulated, under sufficient magnification, a reproduction of the letter looked at would be seen raised up and composed of the uncontracted outer limbs of the cones."

Then, as our gaze travels across this printed page, those tiny muscle bodies are constantly extending and contracting according to the pattern of light and dark upon them.

Suppose these "muscles" are sluggish from toxins or inefficient through lack of use because of a long uncorrected error of refraction? Amblyopia!

There are, of course, other causes of amblyopia, but the fact remains that many so-called "hopeless" cases of dim vision (amblyopia) have been restored to normal acuity by exercise of the muscles of the retina; the calisthenical movement being stimulated by rapid, rhythmical alternations of light and darkness.

Somewhat slower alternations of light and dark, have brought about relief from photophobia through improvement of pupil reaction; and clinical cases of color blindness now under observation give promise of correction through similar methods.

[In the next chapter Shepard and Mendelsohn will deal with determinative technique (diagnosis) by the most recently developed strictly optometric methods.]—EDITOR, AMERICAN JOURNAL OF OPTOMETRY.

REFERENCES

36. Claud Worth, "Squint."

37. W. D. Zoethout, "Physiological Optics."

38. Von Hippel, "Archives of Ophthalmology, 1898 XIV 286."

39. W. D. Zoethout, "Physiological Optics."

40. F. Treacher Collins, "Arboreal Life and the Evolution of the Human Eye."

41. Claud Worth, "Squint."

42. F. Treacher Collins, "Arboreal Life and the Evolution of the Human Eye," page 54.

THE EFFECTS OF STIMULUS TO THE INTERNAL RECTI

M. W. Dunning, Opt. D.
Beaumont, Texas

The use of the word "evidently" by Koch in summing up his conclusion in "Exertion of Internal Recti Causing Change of Refraction—A Case Report." American Journal of Optometry, Vol. 5, No. 4, page 171, leads me to believe that I will be pardoned if I take the liberty to present herewith a somewhat different opinion as to the facts in the case.

As accommodation and convergence go hand in hand in a definite ratio, rarely, if ever do we find a person who can converge without accommodating or vice versa.

When you call upon your patient to supply an extra stimulus to the internal recti, it is impossible for her, under normal conditions, to suppress the extra stimulus which is, at the same time, supplied to the ciliary muscles. In the case in question, the amount of false myopia manifest is, no doubt, in direct proportion to the amount of divergence overcome.

Any increase in the anterio-posterior axis of the globe of the eye will manifest itself by an increase of the corneal curvatures.

If the ophthalmometer readings are the same, when the eyes are in the natural position (divergent in this case) as they are when the eyes are under extra stimulus to the internal recti (parallel in this case) it is ample proof that there has been no change in the shape of the globe of the eye, and that any change in the refractive status is due to some other cause, namely, accommodation.

You will invariably find that, if through an extra stimilus, one of the extrinsic muscles, in conjunction with its opposing muscle, contrives to change the shape of the globe of the eye, thereby changing the refraction, that the change in refraction thus brought about will be of a positive nature and of a cylindrical form with its axis at right angles to the offending muscles.

As the pull of the extrinsic muscles is posteriorly-anteriorly it is possible that, under certain conditions, the globe of the eye may be shortened along its anterio-posterior axis, but the extrinsic muscles under extra stimulus can never lengthen the globe of the eye along its anterio-posterior axis, which it must necessarily do to make the eye myopic (excepting simple myopic astigmatism).

DR. MAC W. DUNNING,
304 SAN JACINTO BUILDING,
BEAUMONT, TEXAS.

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EDITORIAL STAFF

DR. CAREL C. KOCH, Editor
209 Yeates Bldg., Minneapolis, Minn.

DR. JACK I. KURTZ, Associate Editor
209 Yeates Bldg., Minneapolis, Minn.

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INSTRUMENTS FOR GRAPHING ACCOMMODATIVE FATIGUE AND IMBALANCES OF THE EXTRINSIC OCULAR MUSCLES

Four principal attempts have been made during the past 16 years to make graphic records of the associated efforts of accomodation and convergence. These attempts have resulted in some interesting experimental work and will no doubt in the near future give the optometric profession an opportunity of making permanent records or plots of these ocular functions, during the course of a routine ocular examination.

The first instrument devised to do this work was called an "Ergograph with an Attachment of Rotary Prisms," by Howe who devised it in 1912.[1] The instrument was intended to graph only the development or increase of fatigue of the extrinsic recti muscles. Briefly the instrument consisted of a kymograph, a Crete prism and a timing clock. It was so constructed that prism convergence and divergence alone could be studied. In 1916, Howe devised another instrument[2] which he called an "Accommodation Ergograph" which consisted of merely a kymograph, a test object carrier and a forehead rest. This instrument was used to only graph accommodative fatigue. Both instruments functioned to a degree but each had certain limitations which were later in part at last, improved by Pierce and his associates.

These men first worked with separate instruments as did Howe, and then decided to combine the two if possible. In their first apparatus[3], the original head-rest principle was adhered to. The patient was asked to hold his arm up and pull the test object along the metal bar towards his eyes. The head rest principle they found to be unsound, for as soon as the patient became fatigued, he drew his head away, thus destroying some of the value of the record. Another objection found by Pierce was that in attempting to determine fatigue of accommodation they usually found that the arm fatigued first on account of the strained position. These two objections were eliminated in the next instrument by making a bite-fixation, and by drawing a string attached to the test object carrier over a pulley fastened to the supporting bar under the bit, thus permitting the patient to move the test object carrier without fatigue to the arm muscles. Many pilots in the Air Service were examined with this device during the World War, the findings of these tests having been published during the latter part of 1918.[4]

After using this instrument for some time, an attempt was made to improve the apparatus so that it would record both fatigue of convergence and fatigue of accommodation. The rotary prisms and their driving mechanism were replaced by a simple slider, slotted to receive a card bearing either a dot for convergence testing or a Duane line for accommodation testing. The present apparatus consists of a metal frame along the center of the top of which, running lengthwise, is a flat wooden bar upon which slides an adjustable test object holder. In front of the test object holder and attached to the end of the frame, is an arrangement for holding a long, stiff, wooden tongue depressor. A kymograph and drum are enclosed in the frame, so placed that the drum may not be seen by the patient, and on the side of the frame, easily accessible to the patient's right hand, is a slider carrying a pen which writes on the drum, making a vertical single rule graph. The slide is attached by a cord to the test object holder, so that as the patient moves the slider, he simultaneously draws the test object towards him and writes a record of the movement on the drum.

The instrument is used as follows: The patient is seated facing the test object and is asked to bite the tongue depressor firmly. The test object carrier exhibiting a black dot, two millimeters in diameter is then brought up to the eyes until doubling occurs and this is repeated ten times. The average of these ten readings is then taken as the near point of convergence. The test object is then carried back thirty millimeters and the patient is allowed this amount of relaxation after each effort. The patient is then asked to operate the instrument and to make repeated efforts at convergence, and in doing so he makes his own fatigue chart. To study accommodation, it is necessary only to substitute the fine line of Duane or some small test letters for the dot.

Berens, Hardy and Pierce have, during the years 1923-1926, used the Combined Ergograph in their practices for diagnostic work and for some treatment work,[5] stimulating convergence by repeated treatments, these consisting of having the patient graph his near point of convergence as outlined above, the graphs showing the progress made from treatment to treatment, these being given at specific intervals as are oculo-prism treatments, over a period of weeks or months.

The first efforts of Howe and the second of Pierce and his associates were directed chiefly in determining by graph, the period of time which would elapse before a serious fatigue would start interfering with, first, the act of convergence, later the act of accommodation and following this, the graphing of the combined fatigue periods of accommodation and convergence. Esdaile[6],[7] and later Aves,[8] approached this problem of graphing muscular defects from an entirely different angle. The Myophoriagraph by Esdaile, and later the Deviograph by Aves are instruments which will automatically graph the combined action of the extrinsic muscles while they are functioning in an excursional exercise. In fact, these instruments really plot the different positions assumed by the eyes, monocularly and binocularly, in following a moving object, as in the Myphoriagraph or in moving in a rectangular path from one stationary point to another as in the Deviograph. In other respects, in a general way, the principle and mechanism of the two instruments are similar.

In using the Deviograph of Aves, the test object consists of a black target on which are painted eight small, white circles arranged in the form of a rectangle. By means of a convex lens and mirror, a virtual image of the target is projected which appears to the patient as though situated on a black screen placed 35 centimeters in front of the eyes. The size of the target has been carefully calculated to give a virtual image corresponding with the excursional field habitually used by most individuals without turning the head. Laterally, it gives an angular deviation of about twenty degrees, and vertically of about sixteen degrees. The patient's other eye is completely dissociated by suitable screening, and is unable to see the virtual image.

The patient is placed before the instrument and the head adjusted in such position that the two pupils are level when observed in a separate plane mirror which is provided for this purpose. Removing this mirror the carrier and target is then centered before the left eye. This is accomplished by instructing the patient to observe the image of his own left eye in the center of the reflected target. With a white pointed stylus, the patient then marks out, by letters, **L** when the left eye is being plotted, **R** for the right, on a chart previously placed underneath the screen, the exact positions of the eight small, white circles mentioned before. After the chart has been thus

plotted with the right eye, the target and chart are moved over in front of the right eye and a second graph suitably lettered is obtained with the left eye. The screen being placed at a distance of 35 centimeters from the eye, a displacement of the points on the graph 3.5 millimeters from the corresponding points of the virtual image projected on the chart indicates one prism diopter of deviation. When two graphs are taken, one with the right eye, and one with the left eye, on the same chart, the distance between corresponding points of false projection is doubled so that 7 millimeters difference between any corresponding points **R** and **L** represent one prism diopter defect from perfect fusion in that area.

If the muscular condition is one of regular orthophoria, the eight letters obtained in the right graph will be coincident with the eight letters of the left graph. If the case is one of regular hyperphoria, there will be corresponding displacement of the letters in the vertical direction, while in cases of esophoria or exophoria, there will be corresponding lateral deviation to the right or to the left. Thus permanent records are made of the patient's extrinsic muscle balance.

Pierce in his work on the type, onset and development of accommodative or muscular fatigue by means of graphs and Esdaile and Aves in their studies of muscular imbalances, which by the way, they have found to vary considerably in different parts of the field, are opening up new problems for all practitioners. Their research, besides being of intense interest is also of the utmost importance to optometrists as this type of work will undoubtedly lead to improvements in our technic in handling these cases. C. C. K.

BIBLIOGRAPHY

1. Howe, L. Trans. Section of Ophthalmology. A. M. A., 1912.
2. Howe, L. The Fatigue of Accommodation. Journal of the American Medical Association. Vol. 67, pp. 100-104. 1916.
3. Bernes, C., Hardy, L. H., and Pierce, H. F. Studies in Ocular Fatigue. Contributions to Ophthalmic Science. p. 103. 1926.
4. Wilmer, W. H., and Bernes, C. The Effect of Altitude on Ocular Functions. Journal of the American Medical Association. Vol. 71, pp. 1382-1400. 1918.
5. Bernes, C., Hardy, L. H., and Pierce, H. F. Studies in Ocular Fatigue. Contributions to Ophthalmic Science. p. 106. 1926.
6. Esdaile, A. J. Optical Instruments and Research. The American Journal of Optometry. Vol. 3, No. 9. pp. 268-277. 1926.
7. Esdaile, A. J. Further Research With the Myophoriagraph. The American Journal of Optometry. Vol. 4, No. 2, pp. 38-41. 1927.
8. Aves, O. The Graphic Diagnosis of Ocular Imbalances. The Dioptric Bulletin. Combined Nos. 10 and 11, pp. 439-453. 1927.

BOOK NOTICES

PHYSICAL THERAPY IN DISEASES OF THE EYE, EAR, NOSE AND THROAT. A. L. Hollender, M.D., and M. H. Cottle, M.D. Published by the Macmillan Co., New York City. 307 pages, 81 illustrations.

Most texts dealing with this subject leave the reader with a decided feeling of something still to be desired. This is not true, however, with this work by Hollender and Cottle, just received from the Macmillan Company.

Part One deals with the fundamentals of the subject in such a clear manner that the busy professional man cannot fail to grasp the underlying principles of the therapy in a short study. This portion deals with Galvanic Current, High Frequency Currents, Diathermy, Sinusoidal Current, Radiant Heat-Light, and the therapeutic use of the X-ray, giving all the necessary data in the briefest form seen by the writer, yet going into sufficient detail as to the technical application of each form electro-therapy to satisfy the most critical.

The following portions of the book deal with the electro-therapeutic technique for almost every form of Eye, Ear, Nose and Throat pathology, giving as near as possible in a work of this kind, the specific dosage for the various electro-physical agents recommended. The following is an example taken at random from the book.

"CATARACT. It is well established that no medicinal treatment is effectual against cataract, but the electrical currents hold out some hope in selected cases. Negative galvanism merits a thorough trial. Daily operations over a long period are necessary and persistency in this regard will often be rewarded by results. The high frequency currents, too, should be given a trial. Use may be made of the improved eye electrodes for this purpose. With diathermy also persistence is necessary. No claim is made that cataracts can be cured by electrical currents, nevertheless, eye surgeons have recognized that some of the electrical currents prove successful in some incipient cases.

"The administration of calcium salts and thyroid extract has been recently suggested as an adjunct in the treatment of incipient cataracts. These remedies may be beneficial to patients in whom an etiologic indication has been established. General radiations with the ultra-violet lamp are now employed for obvious reasons.

"To much emphasis cannot be laid on the importance of eradicating every focus of infection which can be detected. Systematic elimination will deter the rapid progress of a cataract in many patients.

"Diabetes, syphilis and other diseases which may act as direct or indirect causative factors, require specific treatment.

"Cataracts, other than those incipient in character, should not be treated with physical agents, until further experimental work with electro-therapeutic methods conducted by many investigators shall throw more light on this important subject."

"Harris advocates electro-therapy, rest and exercises in the treatment of cataract. His technic embraces pneumo-massage by means of a small pump giving suction with release (1-1¾ in. stroke, 60-600 vibrations per minute) for three minutes; high frequency for seven to ten minutes; constant current (3-10ma) ten to fifteen minutes (changing once a week or oftener, according to conditions, from the constant current to the galvanic sinusoidal); palming thirty minutes three times daily; flashing and swing both for "far" and "near," as often as possible; vibration of the third, fourth and seventh cervical vertebrae with a hard vibratode for three minutes. The patient must be taught to apply palming, flashing and swinging himself, and he should continue these exercises at home. The duration of the course of treatment varies from three months to two years."

"Harris briefly reports eight illustrative cases. He is convinced that incipient senile cataract can usually be cured in this way. In cases of long standing without choroidal changes, the vision can be improved, and the disease arrested and occasionally cured."

For those wishing to do experimental work in this specialized field this new text of Hollender and Cotle will prove of value, as it contains many splendid references, and for the practititioner who is just starting the use of these valuable aids in treating disease, this work will prove indispensable.—C. C. K.

INTRODUCTION TO THE STUDY OF THE ANATOMY AND PHYSIOLOGY OF THE EYE. Dr. Max Coque, B. Sc., Principal of the British Optical Institute, with a foreword by Mr. J. H. Sutcliffe, O.B.E., F.Inst.P., secretary of the British Optical Association. Published by the J. & R. Fleming Company, London. Distributed in America by the American Optical Company, Southbridge, Mass. 460 pages. 51 illustrations and 14 stereograms. 1927. $9.00.

The first five chapters deal in some detail with an anatomical review of the various parts of the body. Coque, writing this work for the student of optometry, has carefully prepared this portion of the text to present the matter in as clear a form as possible and in the logical sequence. He first reviews the general physiology of the body, giving a brief description of the general arrangement of the various organs. He next mentions the anatomical elements, the cells and fibres and then the tissues which they form, *i. e.*, the epithe-

lial tissue, the connective tissue, the muscular tissue, the nervous or sensory tissue and the blood and lymph tissue. This matter in the first five chapters is all very clearly presented.

Chapter six deals with general pathology as it effects these tissues, he pointing out, that on the whole, pathology should be regarded as merely a modified form of normal physiological process. He describes the action which takes place in a tissue when an inflammation is present. Also the irritating action formed by the presence of microbes or harmful bacteria. General degeneration of living tissues, metastasis, ulceration, tumors and death are dealt with in order named, Coque describing in detail the physiological reaction to each of these so-called pathological processes.

Chapter seven is one of the longest in the book and should have been divided into four separate chapters, which would have permitted the writer going into even more detail on each of the four subjects covered, these being first, the action of light on the human system; second, sensations; third evolution of the eye, and fourth, the embryology of the eye. He mentions the therapeutic value of the ultra-violet ray and also comments on the important part played by oxygen as well as the ultra-violet ray in giving nutrition and life itself to the tissues.

Chapters eight to seventeen contain a most complete review of the anatomy and physiology of the eye and its appendages. Coque has spared no pains to make these chapters as complete as possible, giving the newer theories on physiology of vision in comparison with those previously held by physiologists. Every organ of the eye is described and its entire function outlined.

The use of focal illumination and the slit lamp is mentioned in chapter eighteen, while the writer goes into some detail as to the technic of dissection and of making sections for microscopic study in chapter nineteen. Much of the later material is new to optometric texts and should prove stimulating to many practitioners.

A twelve page appendix deals with the fourteen stereograms which accompany the work. These have all been carefully prepared, the first particularly being very good. The text also contains a complete glossary, bibliography and index.

A careful study of this treatise is suggested as much of the material contained herein is new and its presentation is clearer than that found in the average text on this subject. C.C.K.

ABSTRACTS

FIELD VISION AND NEAR VISION. Freelan Fergus, M.D., LL.D. Eye, Ear, Nose and Throat Monthly, March, 1928, p. 100.

In a paper presented before the Royal Philosophical Society of Glasgow, Dr. Fergus claims that there is a vast difference between *macular vision* (visual acuity) and *field vision* (visual efficiency), which is peripheral. Macular vision has been properly evaluated and is expressed by a formula of the Snellen letters, the same is not true of field vision.

Dr. Fergus claims that field vision has the following important functions:

1. It has a light sense, which up to a point gives a certain form sense.
2. It has a color sense, which, however, is modified in some persons by the presence of color blindness.
3. It has sense of projection.
4. The periphery of the retina, as well as its central parts, has vision, which is very excellent for the perception of movements.

A person may be near-sighted and not be able to read certain size letters at twenty feet without his correction or have a near point of only a few inches and still be able to see with his uncorrected eyes an object at sea many miles away. To prove this contention, Fergus made himself considerably myopic artificially by using strong plus lenses in front of his eyes and he could still see in a semi-dark night, an island eight miles away from him.

He also points out, in support of his contention, that persons with uncorrected high refractive errors can go about doing their regular work very efficiently.

Fergus concludes that if we test men for work or motor driving by using test letters a great number will be rejected as unfit who are quite capable of doing their work well and efficient. For in testing by letters we merely test the macular vision, which is the visual acuity and not the field vision. It is this latter function that men mostly use when working or driving a motor car. J. I. K.

HEREDITARY PARALYSIS OF AN INFERIOR LID IN THREE GENERATIONS. E. Bartok. Kleim. Monat. Fur. Aug., 1926.

In a grandmother of 57 years, her daughter, 35 years, and the latter's daughter, 9 years, Bartok observed a form of monolateral paralysis of the right inferior lid, exposing a few millimeters of

sclerotic under the limbus. The anomaly is not congenital but developed during the first years of life. He believes it can be caused by an aplasia of the orbicularis or of the facial nucleus, though neither one present other functional disturbances. G. L. DuP.

THE ELECTORETINOGRAM. Kahn and Lovinstein. Graefes' Archives of Ophthalmology (German). 1924.

Their research consists of modification of electrical currents of the retina under changes of light intensity. It was found that the amount of current generated varied with intensities of illumination and that the curves followed certain distinct and typical characteristics. The title of the article refers to the name of their apparatus. G. L. DuP.

ALLEN—A MAN WHO WAS AHEAD OF HIS TIME. R. M. Peckham. The Optical Journal and Review. Vol. LXI., No. 11, pp. 27-30. 1928.

E. T. Allen, a physician, and author of the book, "The Science of Higher Prisms," published but not widely distributed in the year 1900, held the same views as does Peckham regarding the application of prisms, although the work of Peckham was done independently, and without the knowledge of the previous work of Allen. Peckham's paper also briefly reviews his own work on hypotonicity. T. O. B.

DIVERGENCE EXCESS; ITS DIAGNOSIS AND TREATMENT. J. H. Dunnington. Archives of Ophthalmology. Vol. LVI, No. 4, pp. 344-350. 1927.

Dunnington claims that upon looking at a distance of twenty feet or more away there is a complete relaxation of the power of convergence and an active stimulation of the divergence center. To diagnose divergence excess, one is to be guided by the following findings:

1—Marked exophoria for distance.

2—Excessive prism divergence (abduction).

3—Normal prism convergence (adduction).

4—Normal muscular balance at thirteen inches.

5—Normal near point of convergence.

6—Lateral movements of each eye inward and outward normal in extent and comitant.

7—Diplopia, if present, not increasing to right or to left.

All of these signs are considered by the author in some detail. In discussing the differential diagnosis, Dunnington claims that the two chief conditions to be confused with divergence excess are convergence insufficiency and insufficiency of an adductor.

Convergence insufficiency, he claims, shows normal distance findings, marked exophoria at thirteen inches and a remote near point of convergence. Also an excess of divergence gives normal near findings and abnormal distance ones. The differentiation lies in doing muscle tests for distance and for near. Consideration of which is pathological will tell one the etiology of the exophoria present. If an exophoria is greater in amount at twenty feet than at thirteen inches it is primarily due to a divergence excess. If the exophoria at near range is more marked it is caused by a convergence insufficiency.

From an insufficiency of an adductor (internal rectus, superior and inferior recti) divergence excess is differentiated by the fact that in the former condition either the power of movement of the affected eye inward is obviously impaired or at all events the exophoria and the crossed diplopia increase definitely as the eyes are carried to one side or the other.

Dunnington also claims in many cases a divergence excess becomes complicated with a secondary convergence insufficiency or vice versa. When the divergence excess is the primary condition a marked exophoria for distance with a smaller amount of exophoria for near will show. Frequently in such cases there will be a divergence squint for distance and only an exophoria for near.

Divergence excess also, he claims, may be present for years without causing any symptoms. The majority of these cases, however, experiences difficulty in overcoming this esophoria. They have headaches and pronounced asthenopic symptoms together with a sense of confusion on watching moving or brilliantly illuminated distant objects. These patients will always show a secondary weakening of the power of convergence. Their symptoms are then due to the convergence insufficiency which has been caused by the divergence excess. In still others, the gastric symptoms predominate.

A primary divergence excess, he says further, may remain stationary for years, however, the tendency is for the condition to slowly progress. If these cases are neglected the exophoria for distance gradually becomes more and more marked until the patient is no longer able to overcome the tendency of his eyes to deviate outward and he develops an actual divergent strabismus for distance. Accompanying this change in the distance findings is a gradual progressive weakening of the power of convergence until finally a constant divergent strabismus for both distance and near will result. In those cases where the convergence insufficiency is primary and the divergence

excess secondary the order is just reversed. These patients have first a divergent squint for near then later one for distance. In either case the final result is the same—a concomitant divergent strabismus.

The line of treatments suggested by the author is purely surgical as he contends that in cases where there are small amounts of esophoria of 5° or less no prisms are needed and where the amount is greater, prisms will not help. Exception to this line of treatment is made by the reviewer of this article as well as by many other optometrists who had the opportunity of applying oculo-prism treatment in these cases, as it is all too well known, that the great majority of these cases can be relieved by treatments alone. J. I. K.

THE VALUE OF THE DIAGNOSTIC LABORATORY TO OPTOMETRY. M. B. Wolff, M.D., and G. Purvis, D.D.S. The Optometric Weekly. Vol. XIX, No. 5, pp. 159-161. 1928.

Optometrists are urged to make a more complete use of the findings as developed in the diagnostic laboratories. Wolff and Purvis advising practitioners to add to their optometric diagnostic tests the findings of a urinalysis, blood count, Wassermann, bacteriological smears, etc., as could easily be done in centers where patients were referred to these laboratories to have these tests made. Emphasis is placed in this paper, on the ocular diagnostic value of the hemoglobin percentage and the leucocyte count. C.C.K.

THE CORRECTION OF CILIARY SPASM. H. B. Marton. The Optician (British). Vol. LXXIV, No. 1915, p. 286. 1927.

Marton advises the use of base-in prisms with full dynamic skiametry findings for treatment wear for periods of from two to four weeks to relieve ciliary spasm.

T. O. B.

LIGHTING IN THE FACTORY. A. M. Hudson Davies. The Optician (British). Vol. LXXIII, No. 1895, pp. 391-396. 1927.

Davies writing on factory illumination in England finds that dirty windows and stained walls are one of the chief contributing factors in lessening the total illuminant which reaches the worker, this being particularly true in factories in which the employees have to rely upon daylight for at least part of their illumination. He strongly recommends the use of the daylight lamp in industry especially where any color matching is to be done.

T. O. B.

ANNOTATIONS AND SOCIETY PROCEEDINGS

The American Journal of Optometry is the official Organ of the American Academy of Optometry, as well as the Organ of the Arkansas, Delaware, Iowa, Maine, Maryland, Michigan, Minnesota, Nebraska, North Dakota, Oklahoma, Pennsylvania South Dakota and Vermont Optometric Associations.

The following gentlemen have consented to supply items of interest from their respective sections, acting in the capacity of

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A STAND ON OPTOMETRIC ADVERTISING

The question is frequently raised, "What percentage of optometrists advertise by means of display space in newspapers?" No one seemed to know. Guesses varied from 5% to 35%. Judging from the space devoted to the subject in optical trade weeklies the later figure seemed correct, yet we were loathe to believe that such a large percentage of optometric practitioners were so thoughtless of their own reputations as to thus jeopardize them in this way, and, in an effort to secure data which was supported by facts, a questionnaire on this subject was sent, by this Journal, to an optometrist, in whom we had confidence, in nearly every first-class metropolitan center in America as well as to most of the smaller cities.

Without going into too much detail as to the outcome of this national wide survey, let it suffice to say that on an average of 14½% of all optometrists practicing in cities of 7,500 or more population are today using display advertising space. This figure compares rather favorably with the 10% figure as recently compiled by the American Dental Association, although their survey included the practicing dentist in the smaller centers as well as those in the metropolitan areas.

However, we believe, this figure far too large for the well-being of the profession, and we also feel that inasmuch as slightly more than 85% of the optometric practitioners of America, and this includes Canada as well as the forty-eight States of the Union, do not believe in advertising, as evinced by their refusal to use it, that the

remaining 14½% should be forced in line, for the common good of all, or else dropped from the rolls of organized optometry. On either the universally accepted standard of majority rule, or on the similar basis of, "the greatest good for the greatest number," this we believe to be a fair proposition, for, as we have pointed out before, advertising on the part of a professional man is both injurious to his own reputation and community standing and to the profession at large which he represents, to say nothing of being decidedly unethical. Inasmuch as this is true, we feel that optometric societies throughout America should now take definite stands on this matter.

The time has arrived for our professional state societies to place the advertising optometrist "Outside the Pale," just as other professions have ousted the quacks which in small numbers infest their ranks.

C. C. K.

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A TOUR OF THE NORTHWEST BY DR. R. M. PECKHAM

Dr. R. M. Peckham, optometrist and lecturer of Waterbury has just completed a lecture tour which started at Milwaukee and ended at Portland, Oregon. He lectured in the following cities: Milwaukee, Wis., Rockford, Ill., Cedar Rapids, Iowa, Sioux City, Iowa, Sioux Falls, S. Dak., Minneapolis, Minn., Duluth, Minn., St. Paul, Minn., Fargo, N. Dak., Butte, Mont., Spokane, Wash., Seattle, Wash., Tacoma, Wash., Vancouver, B. C., and Portland, Ore., groups of practitioners being arranged in advance to hear him, his subject being the newer developments of ocular myology and kratometer technique.

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LOUISIANA ASSOCIATION CONVENTION

The following optometrists were elected to serve the Louisiana State Association of Optometrists at its recent annual gathering. Dr. E. C. Mounce, president; Dr. L. H. Morninveg, first vice-president; Dr. U. S. Meyer, second vice-president, and Dr. J. P. Williams, secretary-treasurer. The meeting next year will be held in Alexandria.

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WISCONSIN ASSOCIATION CONVENTION

The Wisconsin Association of Optometrists will hold their annual convention in Milwaukee, the 2nd to 6th of July. Dr. A. M. Skeffington will be the chief speaker of the convention. The Milwaukee Association is in charge of the program

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PENNSYLVANIA STATE CONVENTION

The Pennsylvania Optometrical Association will hold its annual convention in Pittsburgh at the William Penn Hotel in August. The following convention chairmen were appointed:

General chairman, Dr. Edwin T. Meyer; chairman of general arrangements, Dr. William J. Van Essen; chairman of education, Dr. Albert M. McConnell; chairman of banquet and fellowship, Dr. Thomas H. Martin; chairman of programs, Dr. Howard T. Lewis; chairman of exhibits, Dr. Fred L. Nungesser; chairman of hotels and transportation, Dr. John Hughes; chairman of publicity, Dr. Harry W. J. Seltzer; chairman of registration, Dr. Edward A. Nungesser

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CONNECTICUT OPTOMETRIC SOCIETY

The quarterly meeting of the Connecticut Optometric Society was held at Bridgeport, Tuesday evening, April 10th. Dr. E. LeRoy Ryer, guest speaker of the evening, had for his subject, "Myopia and Its Control By the Use of the Reversed Stereoscope." Dr. Ryer stressed the point of paying more attention to physiology and less attention to anatomy.

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MOTOR VISION COMMISSION

The Motor Vision Commission recommend, says Silver, its chairman, that optometrists who do motor vision work procure discs of glass of the same composition as used in traffic lights and when testing the applicant for color vision, hold these discs of glass separately in front of a round light. One must not hold the colored disc close to the applicant's eye in making the test but at a distance equal or farther than the test letters.

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SOUTH DAKOTA ASSOCIATION CONVENTION

The South Dakota State Association convention was held April the 10th and 11th at Watertown. The program arranged for by the convention committee was almost entirely educational.

The following officers were elected for the coming year: President, Dr. H. N. Smith, Sioux Falls; Secretary, Dr. Wm. H. Fritz, Mitchell; and Treasurer, A. F. Rounds, Mobridge.

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NEW YORK CONVENTION

The thirty-third Annual Convention of the New York State Optometric Society will be held in Jamestown, N. Y., May 27-28-29-30. At a meeting of the committees it was reported that Governor Alfred Smith may be one of the principal speakers at the banquet on Monday evening. Also Dr. James Sullivan, Commissioner of Higher Education of the State Department, and Speaker McGinnis of the Assembly will also be speakers. Counsellor Berg (Julius) and Dr. Bestor of the world-renowned Chautauqua Institution make the Anniversary addresses. Dr. W. W. Bissell will review the advancement of the profession since the passing of the Optometry Law twenty-five years ago. The Educational program will also include Dr. R. M. Peckham.

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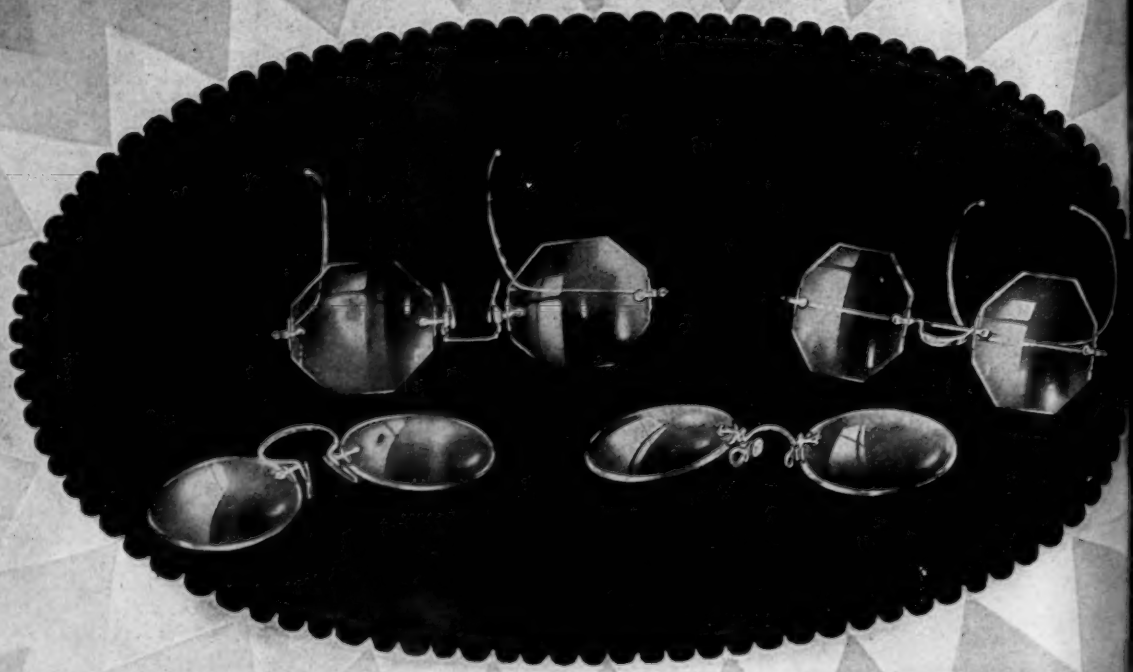

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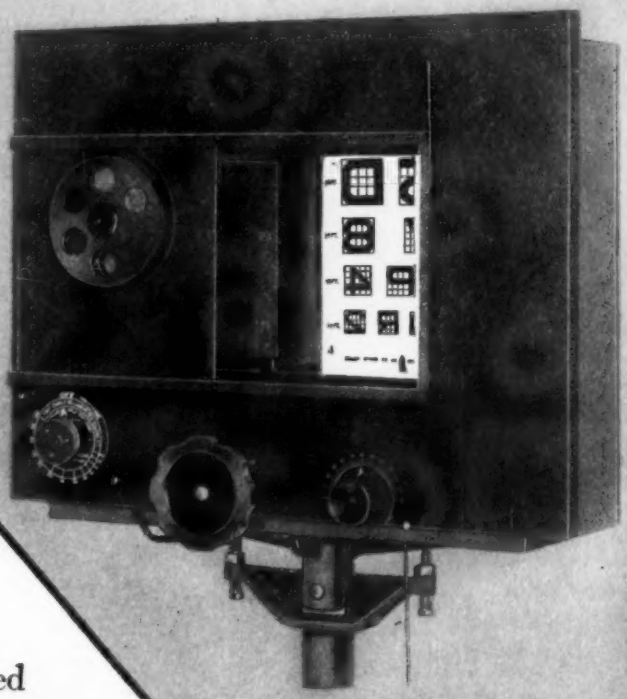

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